The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVIII No. 1241

SATURDAY, APRIL 10, 1943

REGISTERED AS A NEWSPAPER

6D. PER COPY POST FREE 8D.

43

UE
IC
NS

td.

LL,

D
58

A

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

BOUVERIE HOUSE, 154 FLEET STREET, LONDON, E.C.4

Telegrams: ALLANGAS FLEET LONDON — Telephone: CENTRAL 3212 (10 lines)

GLASGOW: 116, Hope Street (Central 3970) — BIRMINGHAM: Daimler House, Paradise Street (Midland 0784-5)

THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers Limited.

VOL. XLVIII No. 1241 — April 10, 1943 — Annual Subscription 21s. Overseas 26s.

Government Powers over Business

THE business community is gravely disturbed over the potentialities of the situation that has arisen in regard to Government acquisition of private undertakings. The Government has the right, under Defence Regulation 78 to have shares in private concerns transferred to Government nominees if it appears to the "competent authority" to be desirable. It was clearly understood that this right would be exercised only when a firm was incapable under its existing management of pulling its full weight in the war effort. The now notorious case of Short Bros., Ltd., may be within this arrangement, but we cannot believe that Parliament ever intended that there should be permanent confiscation of shareholders' assets. Major Lloyd has asked in Parliament whether it is intended to restore to the firm after the war "full rights of ownership and private enterprise recently taken from them." Much to the disturbance of the House, Sir Stafford Cripps's reply was an emphatic "No." On the ground that "there is no provision in the regulation for the return of shares to the shareholders at the end of the war or at any other time," he has declared that "it would not be proper or competent" for him "to take any steps to ensure the return of the shares to the shareholders after the war." This appeared to the House, and must appear to the business community to be barefaced nationalisation carried out by the bureaucracy in a manner never intended when the original regulation was approved. This view was expressed in the House by Mr. Astor (Fulham), who, while agreeing, as all must do, that nothing must be done to hamper the prosecution of the war, declared that "there is the gravest disquiet at the thought that they (the Government) may be trying to permanently nationalise a firm," and he asked whether "it was right to use a temporary difficulty in production to make a permanent change by a back door?"

While many people will be quite willing to suspend judgment on the merits of whether the management of a particular firm should be replaced because of inefficiency, or alleged inefficiency (for that is the common lot of all business executives and workmen), permanent confiscation (even at a price) of the shareholders' assets and rights is quite another matter. There is no possible doubt that the affair has raised grave

On Other Pages

issues which must be debated and has revealed the existence of powers given to individual Ministers that must be watched closely by the elected representatives of the nation. The extent to which political feeling is entering into this question was clearly shown by the temper of the debate in the House on March 31 when this issue was raised. At the time of writing more than 100 M.P.s have put their names to a motion praying for the annulment of an Order under which Ministers can interfere with the direction of private enterprise.

The affair of Short Bros., Ltd., is not the only one. If it were there would be less to be said. A more disturbing case has been before the Courts in the same week as the Short case was raised in Parliament. Here it appears on the findings of one of His Majesty's Judges that there was interference with private interests in circumstances that could not even be excused on the ground that the firm was inefficient. The Minister of Fuel and Power on February 5 issued an Order taking over control of a colliery at Ffynnongroew, Flintshire, owned by the Point of Ayr Collieries, Ltd. According to our records this is the only colliery owned by this company, and it is of modest size, though employing several hundred men. The colliery company disputed the Order before the Court. The facts brought forward were that no criticism had been made about the management at any time, and that, in fact, it had the highest production per man of all collieries in North Wales, possibly in the whole country; it had the best safety record; and since the coal strike of 1926 there has not been a single stoppage there, official or unofficial. What may be an essential feature of this case is that the men employed at this colliery have formed a union of their own and have left the official miners' union. It appeared from the evidence that the Minister was advised that there was the likelihood of a strike and took action without inquiring into the truth of the information, which was claimed to be entirely false.

The defence to this case was, in our humble opinion, extraordinary. There seemed to be no attempt to justify the action taken. The Solicitor-General merely submitted that the Court had no powers in the matter. The Minister's decision was absolute and unarguable. He has only to state that a certain course of action is necessary for the efficient prosecution of the war and the maintenance of supplies and services; any Minister is made the sole judge and jury of his own case. The Solicitor-General added (*The Times* Law Report, March 30): "Even if the Minister had made the order under a misapprehension, the Court could still not interfere." Mr. Justice Singleton (*loc. cit.*) was satisfied that the colliery's case was a good one. "Over a long period the colliery had had a wonderful record from the point of view of accidents, output, and work; it was an amazingly good record in every respect . . . It struck one as a little surprising that a colliery with the best record should be the one colliery which the Minister selected to put under control."

The learned judge was forced to declare, however, that it was not for the Court to say whether the Minister had acted reasonably or not, and for that reason alone the plaintiff's action failed. It is obvious that issues of the gravest moment have been here disclosed. We thought that we were fighting on the side of democracy and against dictatorship. We shall make no further comments on this case, however, beyond bringing it to the notice of the business community, and shall content ourselves with repeating the judge's comments (*loc. cit.*): "Mr. Justice Singleton pointed out that although the plaintiff's action failed, there were other considerations of a public nature to which he must refer. The Minister ought, obviously, to satisfy himself as to its necessity before making an order of this kind, which clearly ought not to be made lightly, though there might be circumstances which would necessitate speedy action. In this case the owners, managers, and workmen of the colliery had a record of which they might all be proud, and he could not believe that there was really any serious threat of trouble. If there had really been any prospect of trouble he could not help thinking that some other way might have been found for dealing with it. And if in such a case the Minister thought it necessary to take control of a business, he might at least inform the owners of the grounds on which he was acting."

NOTES AND COMMENTS

The Future of Chemical Engineering

THE annual meeting of the Institution of Chemical Engineers, always a well-attended function, proved even more popular than usual this year, and circulation before lunch in the large reception hall at the Connaught Rooms almost developed into a problem. Both of the addresses presented to the Institution were full of meat, and members and friends who attended the function certainly did not waste their time. Taking advantage of the custom of the Institution which permits retiring presidents to frame their addresses in a general form rather than around a particular topic of chemical engineering, Mr. Garland spoke, in his own inimitably graphic style, of some problems that will face the chemical engineering industry in the future. It is not surprising, considering the independence that British chemical engineers have always shown, that the president of their Institution should have condemned much of the planning that is in the mode to-day. He insisted on the necessity for the continuance of private enterprise as being essential for providing the stimulus to progress and averred that the small business must be allowed to live and grow. It remains to be seen whether this will indeed be the best way of developing our industries in the years following the present war, or whether some form of combination would not be preferable, if only to enable the benefits of research and discovery to be spread over as wide a field as possible. This question, at all events, is one which merits deep and prolonged consideration.

Co-ordinated Production

AFTER luncheon, the Minister of Production gave a heartening description of the way in which the output of the various kinds of factory under his charge had increased during the past twelve months. He insisted, moreover, on the need for co-ordination between scientific design and discovery which is essential to fit in with the vast complex of operational factors which go to make up anti-U-boat warfare, for example. Here, of course, chemical engineers have their special opportunity, it being their task very largely to interpret and to translate into concrete form the discoveries whereby processes can be improved and made economically and commercially workable. The fact that the desired co-ordination has been very largely attained, as Mr. Lyttelton assured us it had, redounds to the credit of the chemical engineers, as well as to that of the other confraternities of working technologists. It was also good news to be assured that the Production Ministry is supplementing the efforts of our scientists by arranging that the aid coming from America is complementary to our own achievements, thus avoiding redundancy and the consequent waste of invaluable shipping space. Although, as Mr. Lyttelton confessed, he has had a classical education, the Minister of Production appears to be fully abreast of the vast technical and technological problems which his Ministry must face, in an engineers' war such as we are waging to-day.

Bombs on German War Industry

WHEN the German begins to squeal about the destruction of cultural monuments, it is time to look around and consider the true reason for his indignation. It can be postulated, we think, that he has no special reverence for cultural monuments as such, and it is generally agreed that he *does* take an interest in his own war-industry plant. The Ministry of Economic Warfare is, therefore, we consider, justified in assuming that our bombing offensive of the last three months has created damage of very great importance to the German war industry. At a recent Press conference organised by the Ministry, it was stated that the amount of industrial damage inflicted by bombing Germany during that period had been on a very much larger scale than anything in any comparable period so far. The seriousness of the effect of this attack is accentuated by the fact that the Germans have now no margin in their war economy; in anticipation of a short war, they have allowed a part of their industrial capital, such as machine tools, to become exhausted, and the arrangements for replacement require revision. There is difficulty, of course, in assessing the exact amount of drop in production that

is due to any single reason. Bombing is not the only adverse factor affecting German industry; the reverses in Russia have caused the dilution of skilled labour, and the introduction of forced foreign labour, though it has enabled the German factories to carry on somehow, has not speeded output. One thing at any rate can always be safely attributed to bombing—it forces the enemy to do things he does not want to do, *e.g.*, putting up the buildings the R.A.F. have knocked down. Repair services are expensive when the industrial margin is narrow or non-existent.

Research in the Steel Industry

MR. JOHN E. JAMES, chairman and managing director of the Lancashire Steel Corporation, Ltd., at the annual general meeting of the company last week, had some interesting comments to make on the subject of research, in the course of his address to shareholders. "The war," he said, "has revealed to the industry more than ever before the value of research and its effect upon the technical side of the industry, and greater provision for research will naturally require to be made in post-war years than has been devoted to this purpose in the past. The investigations which will be necessary can, I consider, be done most effectively both by individual companies and by the industry acting collectively. Individual companies, for example, might develop those types of research in their laboratories which can be pursued and tested in their own works, transferring thereafter to collective research the results of these investigations." Such a combination of individual and co-operative research has long been advocated in our columns. Is it not possible that therein lies the best solution of post-war development problems?

Grass Drying

UP to the outbreak of war the development of grass drying on farms was slower than could have been thought possible, according to the opinion expressed by Mr. W. H. Cashmore, of the National Institution of Agricultural Engineering, in a paper presented to members of the Society of Chemical Industry in London last week. It is common knowledge that dried grass is a highly nutritious animal feeding stuff, the best comparing favourably with bought concentrates, but there seems to be divergence of opinion as to the reason for this. Mr. Cashmore stressed the fact that it contained carotene (notable for its vitamin-A content), in addition to high crude protein. Dr. Lampitt, from the chair, however, said it was a moot point at present how far they could estimate carotene. Personally, he said, he would not like to give definite judgment on the efficiency or otherwise of a method of drying simply from a chromatographic method of determining the carotene present. Quality cannot be added to the product when once it is dried, therefore it is the farmer's duty to grow the crops best suited for the purpose, and then, irrespective of the carotene or protein content, the finished product will suit his purpose, provided that he does not damage it in drying.

Economy in Valves

METALS used for the manufacture of valves of all descriptions are now in demand in other directions, therefore it is as well to take great care of valves already in use or in store as spares. Additional supplies are limited and there may be considerable delay in obtaining spare parts or replacements. A valve should never be installed so that it carries the weight, sag, or expansion of a pipeline. Proper supports should be provided to take weight and sag, while expansion must be taken up by expansion bends or joints. A valve should never be installed while it is in the open position; the risk of twisting is lessened when the valve is closed. Threads cut on pipes which are to be screwed into a valve should not be cut over-length, because an over-length thread can easily allow the pipe to "shoulder" against the valve seat and injure it beyond repair. Do not apply grease or paint to the threads in the screw ends of the valve; it should be applied to the threads on the pipe and then it will not reach the valve seat where it will collect grit or scale. Valve seats can be ruined by grit when a new or altered pipeline is not blown out before being put into service. A leaking valve should never be "forced," as leakage, except in the case of a worn valve, is generally caused by foreign matter on the valve seat, and this can be removed by opening and closing the valve in quick sequence with an effect akin to flushing.

Boiler-Water Treatment—II

The Use of Zeolites

by D. D. HOWAT, B.Sc., Ph.D., F.I.C., A.M.I.Chem.E.

(*Continued from* THE CHEMICAL AGE, *April* 3, 1943, *page* 370)

WATERS from cold lime-soda softening plants often tend to deposit small quantities of calcium carbonates and magnesium hydroxide scale, precipitation occurring most commonly in long mains, coolers, and economisers. This "after-precipitation" may arise from incomplete settling and sedimentation and from the formation of unstable supersaturated solutions of carbonate and hydroxide. Complete precipitation of magnesium hydroxide is particularly difficult to effect. The presence of even small quantities of this scale with their attendant loss of heat transfer is very undesirable in such gear as coolers and economisers. The addition of suitable coagulants, *e.g.*, aluminium and iron sulphate and sodium aluminate, in the actual lime-soda process itself will greatly reduce the tendency to "after-precipitation." As already noted, these reagents materially assist in carrying the softening reactions to completion while the electrically charged flocs of aluminium hydroxide combine with the very minute particles of calcium carbonate and magnesium hydroxide to accelerate complete precipitation.

Avoiding "After-Precipitation"

Two main methods have been advanced to counteract this trouble. (*a*) Carbonation (frequently adopted in municipal softening plants) involves treatment of the effluent from the softeners with carbon dioxide gas. This method is highly effective in preventing "after-precipitation," but unless very carefully controlled lowers the *p*H value to such an extent that corrosion of the iron pipes results. (*b*) In the second method, the "Threshold Treatment" discovered by Rosinstein,[5] very small quantities of sodium hexametaphosphate are added to prevent precipitation of calcium carbonate. Extensive research by American investigators,[6 7 8] has established the following facts:

1. To inhibit "after-precipitation" completely the amount of sodium hexametaphosphate required is very minute, usually of the order of 2 p.p.m. (0.14 grains per gallon). *See* Fig. 5, illustrating results obtained by Partridge and Hatch.[8]

2. A relatively high *p*H value, *e.g.*, 10, may be maintained, so assisting in prevention of corrosion.

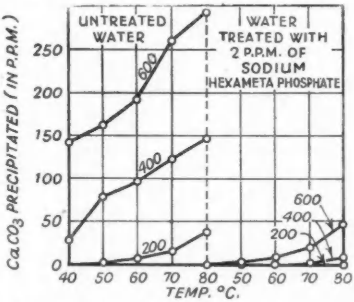


Fig. 5. Inhibiting effect of 2 p.p.m. of sodium hexametaphosphate in precipitation of $CaCO_3$ (Partridge and Hatch).

Synthetic waters prepared by mixing equivalent amounts of calcium chloride and sodium bicarbonate to produce the indicated initial hardness as $CaCO_3$ were heated for one hour at the respective temperatures.

3. Gradual removal of existing scale appears to take place.

4. In waters of comparatively low *p*H, corrosion of iron and steel pipes is inhibited by hexametaphosphate in the usual amounts of 1 to 3 p.p.m. The suggested reason for the protection is the adsorption of the reagent or a complex thereof on the metal or metal oxide surface.

Zeolites

The actual discovery of the base-exchange property of zeolites was made in 1850 by Thomas Way, an English chemist. The commercial application of the minerals in water-softening was developed by Robert Gans, a German, during the first decade of this century. Various naturally occurring minerals, such as zeolites, glauconites, greensands, and fullers' earth, possess the property of base-exchange to a greater or less

degree. The important constituent of all minerals of this type is a hydrated double silicate $Na_2O. 2SiO_2. Al_2O_3. 6H_2O$. The sodium in the mineral is exchanged for the calcium or magnesium ions present in the water, so forming the corresponding highly soluble sodium salt.

After the active sodium in the alumino-silicate has been replaced by calcium and magnesium the material is regenerated by treatment with a solution of sodium chloride. A 4 to 7 per cent. solution of salt is employed, the volume necessary for regeneration usually amounting to between 1 and 4 per cent. of the volume of water softened during each cycle. The water for treatment is normally allowed to flow downwards through the bed of base-exchange material. The regenerating solution introduced at the bottom is forced to flow upward, turning over and expanding the bed during its progress. The naturally occurring minerals may be crushed and screened, a selection of suitably sized particles being made for actual use in the softening plants. Within the past few years extensive research has yielded means of increasing the capacity of the naturally occurring minerals by chemical treatment, methods of preparing synthetic compounds with higher reactivity, and the development of completely new materials with capacities considerably in excess of the original inorganic compounds.

Modern Base-Exchangers

Modern base exchange substances may be classified into three groups:

1. Naturally occurring minerals treated mechanically and chemically to enhance their base-exchange properties.
2. Synthetic minerals produced from the constituents by fusion or by chemical combination in solution.
3. Carbonaceous base-exchange compounds produced by the activating treatment of naturally occurring materials such as coals, peats, and lignites, or by the formation of synthetic resins.

All base-exchange substances show the following advantages when compared with the lime and lime-soda processes:

1. The water obtained is softer.
2. The softener automatically adjusts itself to variations in the water under treatment.
3. There are no difficulties of sedimentation and filtration.
4. There is no sludge to be disposed of.
5. The plant is more compact.
6. The plant may be operated under pressure, so avoiding the re-pumping sometimes necessary after lime-soda treatment.

Some Drawbacks

Certain disadvantages are found in all types:

1. The total concentration of dissolved solids is greater than with lime-soda treatment owing to the replacement by sodium of the temporary hardness of the water.
2. Dissolved carbon dioxide is not removed, so the corrosive action of the water may be increased by the persistence of the dissolved gas.
3. The alkalinity of the water may be unduly high.
4. When used in high pressure boilers the bicarbonate present in the treated water may decompose, giving undesirable quantities of free carbon dioxide and caustic soda.
5. Any suspended solids, colloidal matter, or dispersed compounds of iron or aluminium will be trapped in the medium, causing fouling and reduction of efficiency, so that preliminary filtration is necessary.
6. The efficiency of a solid base-exchange medium must, to a greater or less extent, depend on the developed surface area, *i.e.*, the finer the particles the greater the exchange capacity. A reduction in particle size below 0.3 mm. (approx. −35 mesh) will, however, result in a appreciable head loss. This factor therefore limits the lower size range to which base-exchange media may be crushed.

Numerous attempts have been made to increase the effective surface area of the medium without increasing head losses. The most promising results have been obtained by the production of a porous open gel-structure, particularly those in synthetic resins.

Parker[9] states that though synthetic zeolites for softening water are manufactured in this country, the natural and treated minerals in commercial use are imported mainly from outside the Empire. Various clays and minerals occurring in Britain have been examined at the National Physical Laboratory,[10] where a treated glauconitic sand gave an exchange value of 0.34 lb. CaO per cu.

ft., while a fullers' earth treated in accordance with a special process[11] showed a value of 0.5 CaO per cu. ft.

The Permutit Company claims[12] that a capacity of 0.383 lb. CaO per cu. ft. was

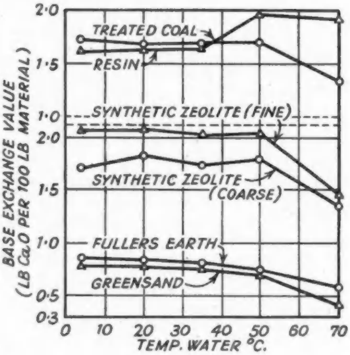


Fig. 6. Base-exchange values at different temperatures of various materials (Ingleson and Harrison).

obtained from a glauconite after the following treatment. A portion −20/25 mesh was treated with 30 per cent. of its weight of sulphuric acid for one hour at 95/105° C. The product, dried and treated in a rotary mixer with a solution of sodium hydroxide, sodium chloride, and sodium aluminate, was then steamed for 20 minutes, washed, and dried.

Two methods of preparation may be employed for the production of synthetic zeolites. (*a*) The fusion process, in which the quartz, clay, feldspar, and soda are mixed together, fused, and then ground to suitably sized particles. The product is a hard compact material possessing a small surface area relative to the mass, while the reaction activity is low. This process does not appear to be extensively used. (*b*) Chemical reaction and precipitation: by noting the salient points of two patents the differences in some of the methods employed may be observed.

In one process[13] kaolin, hydrated sodium silicate ($Na_2SiO_3.5H_2O$), and quartz flour in approximately equal proportions are intimately mixed by fine-grinding in a ball-mill. The product, mixed with 18 per cent. by weight of water, is allowed to set hard. The bricks are steamed in an autoclave at 30 lb./sq. in. until the product no longer gives an alkaline reaction. After fine-grinding, the fraction between 10 and 50 mesh is put into service. In another method[14] sodium silicate and sodium aluminate solutions react to form alumino-silicate gel. The reaction product is obtained in the form of a thin sheet, which is mechanically dried by pressure between two continuous filtering webs. This is followed by dehydration by hot gases on a screen-like conveyor. These products formed in solution by chemical interaction have a gel-structure with a high surface area in relation to mass. Surface activity is high and the exchange properties are very strong.

Materials of types (1) and (2), *i.e.*, treated minerals and synthetic zeolites, suffer from some decided defects in addition to those already noted as common to all exchange media:

1. The efficiency falls off markedly with increase in temperature above 40/50° C. *See* Fig. 6.[19]

2. They tend to increase the silica content of the treated water. The increase in silica arises from the actual (small but definite) solubility of the compounds in water and from disintegration of the material. Very fine materials are produced by attrition of the grains during flow of water through the softener. Marked volume changes occur in the compounds during regeneration, when mutual interchange of different sized ions takes place. The inelastic brittle crystal lattice characteristic of these complex silicates cannot easily accommodate these

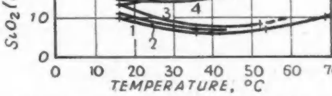


Fig. 7. Increase in silica content with increase in temperature in softened water from different base-exchange materials (Ingleson and Harrison).

1. Hard water.
2. Treated coal.
3. Quebracho-tannin resin.
4. Greensand.
5. Fullers' earth.
6. Synthetic zeolite 10/30.
7. Synthetic zeolite 20/40.

volume changes, a certain degree of breakage occurring with the production of fines.

3. (*c*) The effects of the changes described under (2) become more obvious by working at elevated temperatures. *See* Fig. 7.[19]

Effective base-exchange media may be produced from naturally occurring carbonaceous materials, such as wood, lignite, bituminous coal, or starch, by treatment with a strong mineral acid (*e.g.*, sulphuric acid) or by a strongly dehydrating agent (*e.g.*, zinc chloride). From a study of the patent literature three methods of preparation may be noted:

(*a*) *The Use of Sulphuric Acid.* When concentrated or fuming sulphuric acid is added to wood, peat, lignite, or coal a vigorous reaction occurs with a rise in temperature and considerable increase in volume of the carbonaceous material. According to one specified method of preparation[15] the carbonaceous material, with a granular size of $\frac{1}{2}$ mm., is mixed with two to three times its weight of concentrated sulphuric acid and the temperature raised to about 150° C. The excess acid is subsequently washed out with water, washing being continued until the effluent is neutral. When such substances as sawdust or fine anthracite are treated in this fashion a black syrupy mass is produced. The best results are obtained by allowing the absorption of this syrup on certain porous carriers, *e.g.*, pumice, chamotte, infusorial earth, activated carbon, or silica gel.

(*b*) *Treatment with Gaseous Sulphur Trioxide.* The coal or other material is granulated to a size somewhat larger than that of the finished particles required, to compensate for the attrition that takes place during the reaction. A gaseous mixture of air and 10/15 per cent. of sulphur trioxide is passed into a rotary converter containing the carbonaceous material, the converter being sprayed with water to keep the temperature below 100° C. The coal swells to twice its original volume, absorbing about $3\frac{1}{2}$ lb. of sulphur trioxide per lb. of coal. After thorough washing, the sulphonated product containing 15 per cent. sulphur trioxide (on a dry basis) showed an operating exchange value of 11,000 grains of $CaCO_3$ per cu. ft. under regeneration with 4 lb. of sodium chloride.[16]

(*c*) *Dehydration with Zinc Chloride.* In one patent specification[17] a description is given of the preparation of a carbonaceous zeolite by zinc chloride. One part of finely ground wood meal is mixed with five parts of a saturated aqueous solution of zinc chloride and the mixture heated to 200° C. The product is washed with hydrochloric acid and then with water. The active exchanger may be precipitated on an inert and insoluble carrier such as carbon, pipeclay, or fullers' earth.

Broderick and Bogard[18] investigated some problems relating to the production and properties of carbonaceous zeolites. They found: (*a*) In the treatment of coal by concentrated sulphuric acid at 100° C. for three hours, trouble was experienced from the swelling and caking of the coal. The mixture could not be stirred and the exchange value of the product was poor. (*b*) Treatment of coal with fuming sulphuric acid in a lead-lined rotary converter did not yield highly satisfactory results. (*c*) Very efficient exchange media could be prepared by treating granulated coal with sulphur trioxide in a rotary converter at 170° C. They obtained the best results with coal crushed to −28/35 mesh and a treatment time of four to seven hours. Sulphur dioxide and air in the correct proportion to give sulphur trioxide were passed through a catalyst to a rotary converter containing the granulated coal. (Compare the composition of this gaseous mixture with that quoted above.[16]) The total surplus absorbed by the coal varied from 4 to 5.25 per cent. The exchange capacity of the products was 9500 to 12,000 grains of $CaCO_3$ per cu. ft. The authors point out that there is no apparent correlation between the exchange capacity and the physical and chemical characteristics of the coal from which the medium is produced.

Mechanism of the Changes

The exact mechanism of the changes occurring in the carbonaceous material have not been completely cleared up. Oxidation must take place, as the sulphur trioxide is reduced to sulphur dioxide, while dehydration is also associated with the changes as proved by the effect of zinc chloride. Humic and sulphonic acids of high molecular weight

appear to be formed, the hydroxy groups of these acids presumably functioning as the actual exchange points.

Synthetic Resin Exchangers

In 1935, Adams and Holmes carried out extensive research on the ion-exchange properties of phenol-formaldehyde resins. This work marks an important milestone in the history of the synthetic resins. Up to that date attention had been concentrated almost entirely on the physical properties of synthetic polymers. The discovery of Adams and Holmes emphasised a fact not previously appreciated: that these substances were chemical compounds capable of specific chemical reactions.

Holmes's original patent described the condensation of polyhydric phenols with formaldehyde, the cheapest commercial source of the polyhydric phenols being the tannins. The product of this condensation was a resin with the property of cation exchange. Broadly speaking, the structure of these substances may be considered as an insoluble elastic lattice with chemically active groups functioning as ion-exchangers. The exchange of calcium ions may be considered to take place on the chemically active groups in the following way: $2NaR + CaSO_4 \rightarrow CaR_2 + Na_2SO_4$, where NaR = sodium salt of the synthetic resin. The chemically active areas in such resins are probably phenolic hydroxyl groups.

Increased exchange capacity and ability to function over a range of *p*H values may be obtained by the incorporation of different types of chemically active groups in the resin. For example, increased exchange capacity at low *p*H values is effected by condensing a phenolic body with formaldehyde and sodium sulphite. The active methylene sulphonic groups obtained in this reaction are much more effective under the conditions stated. These cation exchange resins may also be prepared in the hydrogen form, the calcium or magnesium ions being replaced by hydrogen. A very dilute solution of certain acids is then produced with a marked reduction in the total solids content of the water. The reaction in this case may be written: $2HR + MgCl_2 \rightarrow MgR_2 + 2HCl$.

The next development in this synthetic resin work was the production of anion-exchange types. Holmes prepared the early examples by a condensation of aromatic amines, *e.g.*, aniline or N-phenylene diamine with formaldehyde. These early types were hard and impervious, the effectiveness and capacity being largely dependent on the exposed surface area. The available surface area may be increased by preparing the resin as a thin layer on a carrier body of coke or pumice.[20] The capacity and performance of the resin may be modified and improved by the production of specific types of chemically active groups. More strongly basic groups may be introduced by incorporating alkyl groups to form quaternary ammonium salts or by employing amine resins with aliphatic polyamines. Strongly basic guanidino groups may be produced by treatment with cyanamide or dicyandiamide. The anion resins will absorb from water according to the reaction: $X + H_2SO_4 \rightarrow X.H_2SO_4$, where X = anion-exchange (acid-adsorbent) synthetic resin.

Cation-exchange resins may be operated ether in the sodium or hydrogen cycle. In the former case regeneration is best effected by a 4/7 per cent. sodium chloride solution. In common with all ion-exchange media the resins are not regenerated completely, the time and expense of such an operation being quite out of proportion to the gains accruing. In the work of Myers *et al*,[21] a salt regeneration ratio of 0.37 lb. per kg. of $CaCO_3$ removed is recommended.

The Hydrogen Cycle

A very decided advance in water treatment may be effected by operating on the hydrogen cycle. Here the resin—regenerated by dilute solution of sulphuric acid—will exchange hydrogen for all metallic ions present in the water. The total solids content of the water is thereby adsorbed almost to completion, and demineralised water results. If the water is now passed through an anion-exchange resin, the chlorides, sulphates, etc., are absorbed, carbonate ion alone being left in solution. The anion-exchange resins are regenerated by a back-wash of alkali, *e.g.*, sodium hydroxide, sodium carbonate, or ammonia. Final aeration will remove the carbonate ion, producing a water of a degree of softness and purity normally associated with distilled water.

The actual mechanism in ion-exchange and adsorption reactions in these resins

has been studied only to a limited degree. Work by Schwartz and collaborators[22] and by R. J. Myers *et al*[23] gives results which may be plotted in the form of a Freundlich adsorption isotherm. These investigators state that while the process appears in some respects to resemble adsorption, the primary reactions are chemical. The purely chemical actions are so controlled and modified by diffusion and reaction velocity factors that they give the appearance of adsorption. Certain substances were preferentially adsorbed, *e.g.*, sulphuric acid in preference to nitric, and nitric in preference to hydrochloric, the selective action being shown visually by the movement of chromatic bands down through the adsorption column.

The acid absorption powers of the anion-exchange resins is high. Expressed in terms of chemical equivalent the value for the anion types is about twice that of the cation types. Where a cation and anion system is in operation for softening a given throughput of water, the volume of the anion resin need only be half of that found necessary for the cation resin. Unfortunately, these anion-type resins will not absorb the carbonate ion, one almost universally met with in water softening. Thorough aeration of the effluent from the anion resin system is the only effective method for removing the carbonate ions.

Points for Synthetic Zeolites

The carbonaceous zeolites and synthetic resins offer the advantage and suffer the defects already noted as general to the base exchange materials. Certain additional advantages follow from the adoption of the carbonaceous zeolites and synthetic resins.

1. No increase takes place in the silica content of the treated water.

2. The exchangers are not destroyed either by acid or alkali and will operate on waters of widely varying *p*H value.

3. The resins in particular may be manufactured in a porous open gel form in which the exchange activity is largely independent of the surface area.

4. Owing to the low specific gravities, the beds in the softeners may be turned over and expanded during regeneration at rates of flow considerably slower than are possible for zeolites.

5. Attrition losses are much smaller, the lattice of the materials being highly elastic and capable of accommodating volume changes up to 25 per cent. without disruption.

6. Increased exchange capacity is obtained by operating the resins at higher temperatures (*see* Fig. 6). Ingleson and Harrison have shown that out of a large range of exchange media only the synthetic resins show an increased capacity at elevated temperatures.[19]

Some of the carbonaceous zeolites and resins have a tendency to "throw" colour to the water; otherwise these materials suffer from only one disadvantage other than those common to the base-exchangers generally and that is cost. The price does not appear to be stabilised as the materials are still largely in the semi-plant stage.

Only general figures on the capacities of the different types of base-exchange media may be offered. The table given below shows figures at room temperatures for a range of materials, the upper portion being taken from the work of Ingleson and Harrison[19] and the lower portion from Myers, Eastes, and Myers.[21]

Material		Exchange Capacity lb./CaO cu. ft.
Treated glauconitic sand	..	0.34
Treated coal	..	0.76
Treated fullers earth ..	..	0.52
Quebracho tannin resin ..	..	0.72
Imported greensand ..	..	0.69
Synthetic zeolite 10/30 grade	..	1.04
Synthetic zeolite 20/40 ..	..	1.12
Material.		Exchange Capacity lb./$CaCO_3$ cu. ft.
Greensand	..	0.54
Synthetic zeolite	(1)	0.85
	(2)	0.57
Synthetic (fused) zeolite ..	(3)	1.14
Clays (treated)	(1)	0.71
	(2)	1.14
Synthetic zeolite	(4)	1.07
Carbonaceous zeolite ..	..	0.83
Synthetic resin (Amberlite)	..	1.43

All at 4 lb. NaCl per cu. ft. regeneration.

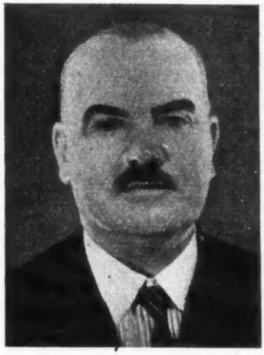
REFERENCES—

5 U.S.P. 20,754 (re-issue).
6 HATCH and RICE, *Ind. Ind. Chem.*, 1939, **31**, 51; 1940, **32**, 1572.
7 RICE and PARTRIDGE, *Ind. Eng. Chem.*, 1939, **31**, 58.
8 PARTRIDGE and HATCH, *Trans. Amer. Soc. Test Mat.*, 1940, **40**, 1329.
9 PARKER, *Chem. and Ind.*, 1941, **60**, 795.
10 INGLESON and SULLIVAN, *J.S.C.I.*, 1941, **60**, 11.
11 B.P. 434,633.
12 PERMUTIT CO., LTD., U.S.P. 2,076,443.
13 B.P. 503,847.
14 U.S.P. 2,244,383.
15 U.S.P. 2,191,060.
16 U.S.P. 2,191,059.
17 U.S.P. 2,191,063.
18 BRODERICK and BOGARD, *Ind. Eng. Chem.*, 1941, **33**, 129.
19 INGLESON and HARRISON, *J.S.C.I.*, 1941, **60**, 87.
20 B.P. 506,291.
21 MYERS, EASTES and MYERS, *Ind. Eng. Chem.*, 1941 **33**, 697 and 1203.
22 SCHWARTZ *et al*, *Ind. Eng. Chem.*, 1940, **32**, 1462.
23 MYERS, *et al.*, *Ind. Eng. Chem.*, 1941, **33**, 1270.

(To be continued)

The Institution of Chemical Engineers

Twenty-First Annual Corporate Meeting



Mr. C. S. Garland, retiring President of the Institution of Chemical Engineers.

THE 21st annual corporate meeting of the Institution of Chemical Engineers was held on April 2 at the Connaught Rooms, Great Queen Street, London, W.C.2, with Mr. C. S. Garland (president) in the chair. After formal business, the following officers were elected for the ensuing year:

President: F. A. GREENE; vice-presidents: H. BEAVER, H. J. BUSH, H. GRIFFITHS, E. W. SMITH, C.B.E.; joint hon. secretaries: A. J. V. UNDERWOOD, M. B. DONALD; hon. treasurer: H. W. CREMER; members of Council: W. M. CUMMING, F. H. GARNER, G. W. HIMUS, J. W. McDAVID; associate member of Council: J. P. BAXTER.

Among interesting matters mentioned in the annual report was that the Institution had been asked by the Director of War Industries and Research in Nairobi to assist in obtaining information concerning the establishment of certain war industries. The President supplemented this by pointing out that Dr. Underwood had rendered great assistance here, and although his services had been voluntary the East African Industrial Research and Development Board had expressed its appreciation by making a grant of £100 to the Institution's Benevolent Fund.

Presentation of the Osborne Reynolds, Moulton, and William Macnab medals followed. The Osborne Reynolds medal, for meritorious service to the Institution, was awarded to Mr. L. O. Newton, of Sofnol, Ltd., Member of Council, for valuable work carried out on behalf of the Institution over many years. The Moulton medal was awarded, for the paper on "Design and Performance of Cooling Towers," to Mr. W. K. Hutchison, A.M.I.Chem.E., and Dr. E. Spivey, while Dr. E. S. Wade received the Junior Moulton medal and award for his paper on "Evaporation of Liquids in Currents of Air." The William Macnab medal for the best set of answers presented in the associate-membership examinations was this year awarded in duplicate, to Mr. J. H. Sharp and Mr. F. J. Wilkins.

A special tribute was paid to the work of Mr. C. J. T. Mackie, assistant secretary, for his unfailing energy and enthusiasm on behalf of the Institution.

The Chemical Engineer After the War

The President's Address

IN his presidential address, Mr. Garland, taking advantage of the privilege accorded to retiring presidents in their "swan song," to speak generally rather than specifically, dealt with some of the after-war problems of the chemical engineer in his professional capacity. "I want to put before you," he said, "a few thoughts of an aspect of the position of the chemical engineer as a citizen, to consider what bearing his training and experience should have on his political situation and that of the country in which he lives and in what direction it enables him to serve his fellows. It is necessary that we should give some consideration to the economic and political structure as a whole if we are to determine the function of the chemical engineer in reconstruction. I know there are some who will say that it is not the business of the President of this Institution to talk politics, but may I reply that I think that the general attitude of all scientific men to what we describe as politics has been and to a large extent is still wrong. We are apt to regard the activities and machinations of the politicians with a kind of amused contempt. It is true that a large number of those who have become prominent in politics are, from our standpoint, intellectual mediocrities. For this state of affairs we, and men similarly trained and with a similar outlook, must bear a full share of responsibility in our indifference to politics and politicians. We who have been taught to seek out and know truth and are able to ascertain the real facts of the case, allow without protest authors and others who have contributed nothing to the material welfare of mankind, to continue to write and talk of a brave new world after the war.

"It is necessary to know not only what

supplies exist in each country, but what means there are or what facilities are possible and necessary for making them available for export and exchange. The dominant position which Great Britain held in the export of coal, cement, and soda salts was as much due to the proximity of the deposits to the seaboard as to their quality. The advantage of our island position, however, does not affect one already ascertained basic fact which has a vital influence on any scheme of reconstruction of industry here. As a nation we are dependent upon supplies from overseas for a substantial proportion of our food and for a still larger proportion of the essential raw materials. As regards the minerals needed in bulk by the manufacturing industry, we have practically only coal, clay and iron ore. We have hitherto been in the habit of making the comforting assumption that the minerals found in the British Empire added to what we have in this country, make up a sufficient percentage of the world's total resources to render us relatively independent. Even this, of course, was not true of such essential raw products as petroleum, of which the Empire has only some 1.8 per cent., of pyrites and sulphur for sulphuric acid, the basis of almost every chemical process, of which 5.6 per cent. and 5.2 per cent. are the Empire share, of bauxite for the production of aluminium, where the percentage is 8.3, and of the potash required for agriculture and the chemical industry, of which we have only .5 per cent.

Misuse of Raw Materials

"We cannot as a nation or as technical men pride ourselves on the use which we have made of the one raw material which we have in abundance. In fact we have regarded coal not as the most important source of carbon compounds, but purely as a combustible for the generation of power—and even in that direction it has been used most inefficiently. Compare the way in which America has developed her natural supplies of carbon. Petroleum is equally with coal a source of motive power or a raw material for the carbon compounds which are the basis of plastics and much of the chemical and synthetic fibre manufacture. Mr. Bennett has recently given some striking figures of the application of scientific research in the petroleum industry in America. In 1920 that industry employed 940 scientific workers. By 1938 this number had increased to more than 5400. Of all the scientific workers in the U.S.A. 11 per cent. were engaged in petroleum research. You will have been glad to have seen the start made here—only a small start having regard to the amount of leeway to be made up—in the creation by the Government and the coal industry of a fund of £1,000,000 for a five-year programme of research on coal as a raw material. I should like to pay a tribute to the share of our past President, Mr. Arthur Reavell, in securing the support of the Government for this project. As chemical engineers we should see to it that we keep in the forefront in the use of the most recently discovered raw material of which this country, for its size, has larger supplies than any other nation except perhaps Japan. I refer to *sea water*. Long ago there were abortive attempts to obtain from it the industrially useless metal gold, but although the proportions present are small, chemical engineering has overcome the difficulty of dealing with immense volumes and it has become the most important source of magnesium and of bromine, both needed in very large quantities for light alloys for aeroplane engines and frames and for anti-knock fuels."

Private Enterprise

Towards the provision of a high standard of living, Mr. Garland went on, "the work of the chemical engineer in reducing costs of production and increasing yields of existing methods, in devising and developing new processes and products, will be of paramount importance. Much is said and written of planning as a panacea for all the economic ills of mankind, but in a world planned after the Napoleonic wars by the pedants of the Civil Service there would have been no place for the railway or railway engine and it is very doubtful whether plans made after the last war would have left provision for the immense developments in the motor car, in radio and in the application of plastics which have been made since 1920. It was very cheering to hear so definitely from the Prime Minister recently that private enterprise, the source of so much that we have to-day, is not to be stifled. I think this is of particular interest to us as chemical engineers. There is probably nothing so closely comparable with the expansion of the living organism as the progress of chemical industry. The new products produced to-day as a curiosity in some chemical research laboratory become in the course of a few years the basis of new industries, themselves throwing out branches in new directions.

"When we remember the many instances in which years of dogged and almost despairing work has had to be done before the potentialities of some new chemical product have been realised—when we reflect from what small beginnings and in what a comparatively short time many of the large chemical and allied manufacturers have grown—how near to total extinction some have been in their early years—we see the vital necessity of our post-war arrangements, financial and economic, being such

that the small business can not only live but grow. The suggested alternative to private enterprise is some form of bureaucratic control and I do not need to remind you of the unyielding resistance which the bureaucrat in his traditional policy of playing safe must inevitably exert against new inventions and methods. When it was first suggested that the telephone should be installed the Permanent Secretary of the Treasury said he could think of no circumstances in which he would not send a messenger or go himself rather than use such an instrument.

A Watch on War Research

" The knowledge of the chemical engineer is essential for the discovery and destruction of the plants, many and varied, on which the war potential of the aggressor nations has depended. It must also be their duty to keep a constant watch on progress of scientific research capable of development for war. Sir Robert Robinson has expressed the view that if the aggressor nations were denied nitric acid or their manufacturing plants for this material were strictly limited to their peace-time requirements they could be effectvely prevented from going to war. I know that early in the present war a member of our Institution advocated that our bombing should be concentrated on this one production of Germany, and there seems much to be said for the complete destruction of such a single vital link in the chain of armament rather than attempting slowly to erode the whole chain. I am not, however, as confident as Sir Robert Robinson that it is unlikely that military explosives not dependent on nitric acid could be produced. At short view he is no doubt correct but I feel sure that any nation with a highly developed chemical industry and a staff of competent research workers could, if denied nitric acid and determined to produce military explosives, ultimately prepare something equally effective. Sir Robert indicated that provision could be made for such a remote contingency, and this could be effected by the creation of a scientific general staff with liaison officers attached to the Embassies who would study the progress of scientific research in the countries in which they were stationed and make the facts and the deductions from those facts available to those who have to decide the foreign policy of the nation. The manufacture of nitrates from the air by the Haber process before the 1914-1918 war, at a time when Chilean nitrates could be freely imported by Germany and nitric acid from the air was more costly than the Chilean nitrate, was to a chemical engineer a signal light. The vast plants erected by Germany between 1933 and 1938 for the manufacture of synthetic rubber and petrol could have no other purpose than to make the country self-sufficient for war. Even more significant in view of Germany's food position in the last war, was the State-supported research work of Bergius for the production of sugar and proteins from cellulose. The Allied Nations might, for instance, determine to exercise some control over the output of aeroplanes by limiting the production of light alloys, but such a protection could be rendered nugatory by developments of plastics of higher tensile strength for the same purpose—already there are plastics available which weight for weight are stronger than steel.

"All these processes depend upon chemical engineering giving added support to my view that it is essential in the interests of peace and of British industry that there should be a scientific attaché to every Embassy. Such scientific assessors need not all be chemical engineers, but they should be men of the independent consultant type who would be attached to the Embassy for a limited period of not more than one or two years at a time. The chemical engineer is particularly suited by his training to appreciate the significance of what is being done. Of all scientific men he has the grounding in the two fundamental sciences—chemistry and engineering—concerned with the conversion of matter from one form to another. A properly-balanced course of chemical engineering study is certainly a liberal scientific education. Under the new circumstances of to-day, is it not possible to revive the proposal which some of us made in New York to the American Institute in 1921—that it should become " The Institute of Chemical Engineers "—an international body of which we would become the British branch. The motion was lost at the General Meeting in Baltimore as the result of a patriotic speech, but I doubt whether isolationism in science is quite so strong to-day, and the formation of an international body would be a real service to the chemical engineers of the Allied Nations. They and we should, of course, have to sacrifice some of our independence, but we all realise that we must be prepared to make sacrifices for the sake of the peace and prosperity of the world.

Reasonable Standards

" Another matter to which I wish to refer is the reaction on our profession of our so-called 'invisible exports.' We appear to have prided ourselves on our shipping and insurance as means of balancing our export-import budget, but I think we are beginning to realise that in the interests of the standard of living of our workmen and craftsmen it is better to make our own goods or to make goods for others than to act as carriers and insurers of goods manufactured by the workmen of other countries. A skilled artisan is at least as useful a mem-

ber of the community as an insurance broker. In this connection it is important that the "playing safe" by the insurance underwriters should not be allowed to handicap British export trade by setting unnecessarily high standards of strength for British manufactures which would put them out of competition with the products of other great manufacturing nations. This is of particular interest to the chemical engineer and chemical plant manufacturer. Much of the plant we manufacture may have a short life because our own advances in process-research and design are so rapid that plant becomes obsolescent long before it is worn out. Your Council has recently found it necessary to give special attention to this matter. A new standard was proposed for chemical engineering plant which was admittedly a compromise between the accepted American standard and the desire of the British insurance companies to have the plants so strong and heavy that the risk in insuring them would be reduced to zero. The large oil companies throughout the world have used these plants to the American standards for many years with perfect safety. The adoption of the proposed standard would increase the British manufacturer's costs by some 15 per cent., sufficient to put him out of competition when tendering for South America, the Far East, or other markets which, as soon as hostilities have ceased, will be in need of such chemical plant to replace that destroyed by the exigencies of war. Your Council has refused to agree to this proposed standard and have made it plain that they will not accept any standard which does not allow British chemical plant manufacturers to compete on reasonably equal terms with plant made to a standard ample for the purpose."

The Institution Luncheon—Mr. Lyttelton's Speech

MR. GARLAND took the chair at the luncheon of the Institution which followed the annual meeting at the Connaught Rooms. After the loyal toasts, Lord Leverhulme, past-president of the Institution, proposed the health of His Majesty's Ministers, coupled with the name of Mr. Lyttelton, Minister of Production, referring to the Minister's services to industry and to his wisdom in seeking the assistance of scientific advisers.

Mr. Oliver Lyttelton, who confessed that he had had a classical education, and that in matters scientific he was a self-made man, said that he recognised the great part being played by the chemical engineer in this war. The part which this Institution had played in stimulating the universities to provide instruction of both undergraduate and postgraduate character in chemical engineering had had a most beneficial effect on the qualifications of the young men entering the industry, and hence directly on our war production. He was particularly impressed by the nature of the qualifying examination, whereby the candidate is judged principally by the way in which he tackles a real industrial problem of some size. When the history of the war comes to be written, one of the Prime Minister's greatest contributions to victory will turn out to be the continual help and the continual pressure which he has given and applied in the field of scientific research and the practical adaption of scientific discovery to the waging of war.

"The war has done remarkable things," Mr. Lyttelton said, "to quicken development and increase productive capacity in the industries that go to produce munitions. The immense efforts of our industrial army have, I think, even now not been fully realised and appreciated. By the fourth quarter of 1942 the rate of output of warlike stores produced for the Ministry of Supply was double that of the average rate in 1941. In the last quarter of 1942 the structure weight (whch is the only true comparison) of our production of aircraft was just about 75 per cent. higher than the average quarterly production of 1941. In February we produced more than four times the number of heavy bombers that we did a year ago. This increased output has been largely achieved by three things, developments by scientists and industrial engineers; increased efficiency of labour; and increased efficiency of management. That output is a magnificent testimony to everybody engaged in industry, to the scientists and engineers for their new discoveries and improvements in the planning, co-ordination and supervision of production in all its phases."

After describing the changing face of strategy presented by the war in its ever-altering aspect, Mr. Lyttelton continued: In this country we are "batch-minded." We have not got a large enough market around our factories to give us the opportunity for universal mass-production, such as can be applied in the United States. Consequently, our manufacturers have designed their plants with a great degree of flexibility. They have attempted to go in for general purpose tools and smaller sized units. This has great advantages and also disadvantages in war. It is an advantage that we are enabled to switch from one type of weapon or from one modification to another with less dislocation than a country that is organised and tooled for a great mass production. But, on the other hand, we find that as we have to dilute our skilled labour forces, as we have done with great success, and as we bring into the factories large numbers of men and women and more

particularly women, who have never been in factories before, it is necessary to break the job down into smaller operations and for these operations specialised tools become necessary. But I think, on the whole, the advantages of flexibility outweigh the disadvantages and it is the constant endeavour of a Minister of Production and of the War Cabinet to use this flexibility to the best advantage and to try and develop new weapons ahead of the enemy. I think we may claim that thanks to the great fertility of our scientists we are in a fair way of achieving this object.

Three Great Problems

Looking for a moment into the future, the Minister insisted that after the war it was essential that we should tackle our problems with the energy that we had developed during the war. There were three great problems that we shall have to face, all vitally concerning the industrial scientist.

First, we had to conquer unemployment. The problem of securing full employment was very much the problem of finding, year after year, worth-while forms of investment in which to embody the immense savings which a great modern industrial nation accumulates when fully employed. The original discovery of such outlets was the task of fundamental research and invention. But the further development and application of their results to actual industrial processes was the task of the industrial scientist, and of the chemical engineer in particular. Second, having dispersed in this war, as in the last, a large part of the foreign investments that we have built up during the past century, we should have to pay with exports for a much larger proportion of our imports. This would be a more difficult task than hitherto. The war had accelerated the process of industrial development in all countries towards self-sufficiency. We should discover exports only by concentrating on those things which for one reason or another our customers were for the moment ill-equipped to produce for themselves. In the export markets of the world there was an immense advantage to the country that led in scientific progress.

Third, we were seeking to make a new world in which we could provide our own people with more of the good things of life. That meant that we must produce more, so that if we were to achieve these new and higher standards we must increase, and go on increasing, our productivity.

" And so," Mr. Lyttelton concluded, " I ask for your help in this third task also—that of improving industrial efficiency and industrial output. I ask you to see that new methods and new ideas are applied to industry as rapidly as human ingenuity can make possible. This country has always been in the forefront of fundamental scientific research, and there is every reason to hope that we can retain this supremacy. But the application of the results of that research to practical needs has sometimes, in the past, been left to the technicians of other nations, so that we have not reaped the full benefit of our own fundamental discoveries. It is here that the chemical engineer must increasingly play his part, in peace as in war, by creating from the discoveries of the chemical research laboratories new and effective processes based on materials economically available."

Among those present at the luncheon, which was attended by nearly 400, were: Mr. F. W. Bain, Sir Peter Bennett, M.P., Dr. W. T. K. Braunholtz, Professor H. V. A. Briscoe, Sir Francis Carnegie, Captain Somerset de Chair, M.P., Dr. William Cullen, Sir Henry Dale, Sir Charles Darwin, Dr. H. J. T. Ellingham, Mr. E. V. Evans, Dr. A. P. M. Fleming, Dr. J. J. Fox, Dr. G. E. Foxwell, Sir William Fraser, Sir Alexander Gibb, Sir Patrick Hannon, M.P., Professor I. M. Heilbron, Professor B. W. Holman, Mr. W. J. Jordan, H. E. E. N. van Kleffens, Professor F. C. Lea, Dr. H. Levinstein, Sir Guy Locock, Lord McGowan, Hon. S. M. Lanigan O'Keeffe, H. E. van Ordt de Jeude, Sir John Nixon, Sir William Palmer, Dr. A. Parker, Lord Rayleigh, Mr. F. Heron Rogers, Mr. J. F. Ronca, Mr. E. W. Salt, M.P., Mr. W. M. Selvey, Professor R. V. Southwell, Sir William Stanier, Mr. R. F. Stewart, Sir John Thornycroft, and Mr. S. J. Tungay.

Chemicals in Eastern Europe

Nazis Claim Progress in Repairs

WORK on the repair and reconstruction of chemical factories in the eastern territories occupied by the Germans is making progress, according to a report in *Die Chemische Industrie*, the official news organ of the German chemical industry. In the Reich-Kommissariat Ostland, a region which comprises the Baltic states as well as White Russia, the entire chemical industry is said to be working again, and in the Ukraine more than 200 factories are claimed to be in operation. It has often been necessary to provide new machinery from the Reich, as the existing machines had been wrecked. Another difficulty was, and still is, the shortage of raw materials. At first stocks at repaired works and neighbouring factories were used up, but later the problem became more acute. The management is in the hands of German " trustees " or " native experts," but the latter are allowed to work only under the supervision of German general commissioners, and more and more are being replaced by Germans.

The Rubber Scarcity

Special Care of Hose and Lined Vessels

WAR conditions have resulted in a scarcity of rubber, but, however scarce it may be, there are important uses for it in the chemical and chemical-using industries, which must be kept supplied, for example, with hose for pumping operations and with tank linings to provide corrosion resistance. It is, therefore, essential to conserve supplies and husband manufacturing facilities.

It is as well to remember that rubber hose should not be left to lie in hot or damp places, or in strong sunlight. When it is not in use, it should be drained and coiled, but do not hang the coil from a nail or give any other cause for damage under influence of suspended weight. If it is in use, avoid excessive temperatures, violent fluctuations of pressure, and unnecessary flexing, and never allow the wheels of a truck or lorry to run over it when it is on the ground. In moving from place to place, straighten the hose before dragging. A pull on a kinked length will tighten the kink and strain the fabric reinforcement, and possibly break the rubber itself. It may be quicker to pull the hose about without particular care, but if the weight is partly lifted when passing rough places an enormous amount of abrasion will be avoided. Wear, in the case of a large-diameter hose, can be distributed over the surface by rotating the hose periodically, and by using ample supports to carry the weight and consequent strain where there is no contact with the ground or floor. Kinking the hose, or doubling it back in the hand, may be quick and easy ways to stop the flow of liquid, but this results in damage, which may not be apparent for some time. All twists and kinks, and sharp bends at fittings, show little sign of immediate damage, but damage nevertheless is done, which is not self-remedied or put right by subsequent treatment. Care is also necessary when attaching couplings; soap and water should be used as a lubricant and the shank of the coupling forced straight into the hose and not wriggled and twisted with uneven strain into its position. A dark cool place is preferable for storage when hose is out of continuous use. Length of life is greatly increased by providing insulated wood cupboards for intermittent protection of hose.

Rubber-Lined Vessels

In rubber-lined vessels, sudden temperature changes and localised heat seriously deteriorate the rubber and its adherence to the metal of which the vessel is made. Localised heat, where heating is necessary for process reasons, can be avoided by effective agitation. For maximum life, rubber should not be subjected to temperatures higher than 65° to 82° C., unless expressly compounded to give service at a higher temperature. It is as well to keep the temperature at the very lowest point which will accomplish desired results in the process. Contact with oil, grease, and solvents must be avoided. Care is needed in selecting a rubber composition which is least affected, if oils are handled. Periodical inspection is desirable in order to detect deterioration and to take measures to repair it. Men entering rubber-lined tanks to make an inspection or to affect repairs, should be provided with rubber shoes because the abrasion caused by heavy boots is serious, even in the case of hard rubber. Physical abuse of a rubber lining must be avoided, and if the edge of an open-top rubber-lined vessel is likely to receive physical injury, it must be protected with wood or other suitable material. Direct sunlight, steam heat, very low temperatures (in situations adjacent to refrigeration pipes), and the discharge of ozone from electric generators and motors can be guarded against by suitably shielding the equipment. When the exposed surface of rubber-lined tanks is painted to prevent corrosion, it is desirable in outdoor situations to use light-coloured paint, preferably aluminium paint, because a dark colour will absorb the light and raise the temperature unnecessarily. Lined vessels likely to stand idle for some time should be filled with a liquid suitable for keeping the rubber in condition. Water is suitable when its *p*H value is controlled and kept constant.

RETURN CYLINDERS

The supply of cylinders for industrial gases is not equal to the demand existing, particularly in the case of oxygen and acetylene to serve welding operations, and empty cylinders must be returned promptly so that they may be refilled with the least possible loss of time. More important is to avoid abuse in use because careless handling can quickly put a cylinder out of service. Oil and grease must be kept away from oxygen cylinders. Contaminated cylinders have to be specially cleaned before refilling, causing additional delay, because oil and grease will ignite violently in the presence of oxygen under pressure and the explosion hazard is serious. In all circumstances protection should be given to the valves by replacing the metal cap when the cylinder is not actually in use. Arc burns are also a common cause of the withdrawal of cylinders from service, but these burns can be avoided by taking care not to knock electrodes against the cylinder or against any metal object which is in contact with the cylinder.

Waste Disposal in War Time*

American Director Surveys the Problems

THE imperative need for production on the industrial war front forces the problem of industrial wastes into the background, where it will probably remain until the war is finished. Yields, economy, clean streams, aesthetic standards, recreational facilities, may all have to be sacrificed temporarily, until we have produced the products needed to win the war. In normal times the mention of waste disposal evokes no warm response from the average manufacturer. Industry is supreme now, and our rivers and water resources should be regimented in the war effort, to do their share in washing away the sins of industrial inefficiency and the soaring tons of waste substances discharged daily from industrial sewers.

Under present conditions, we ought to have a Water Priorities Board that would allocate stream flow and dilution resources for the by-products that come out of the back door of industry, in the same manner that the War Production Board allocates priorities and establishes quotas in the products that come out of the front door. The urgency of our need for critical materials such as alcohol, rubber, foodstuffs, steel, tin, and munitions far transcends the resultant pollution problems of the disposal of mash residues, soap and organic emulsions, packing-house wastes, pickle liquor, acids, dyes and organic compounds. If production can be hastened and the use of critical materials obviated, let our streams deteriorate temporarily, certainly in their aesthetic or recreational aspects. Health standards, however, must be maintained, and corrective measures must be applied if industrial wastes are permitted to increase the hazard to the health of millions of people. Most of our rivers, however, do not constitute such a health hazard, because their waters are not used for drinking purposes, or the river flow is so tremendous as to dilute and oxidise pollution beyond the limits of the sensitive and infinitesimal detection methods of water chemistry and bacteriology.

Studies Lacking

There seems to be an astonishing lack of appreciation among industrial chemists of the metabolism of streams—the significance of bio-chemical oxygen demand and oxygen balance, the seasonal changes of stream bacteriology and biology, the mechanism of self-purification, and the measurement of assimilative capacity for domestic or industrial pollution. It is surprising that even our best managed industries rarely make any attempt to study the relation between their wastes and the watercourses into which the wastes are discharged. It is profitable for an industry, if large enough, to make its own studies of waste problems. Salvage, separation, change of process, substitution of pollution-free ingredients, recirculation, regeneration—these inter-plant procedures should be exhausted before over-all treatment is decided upon. Industrial executives are usually ready to agree that these steps are wise, in principle, and sometimes they make a half-hearted effort to utilise these steps in the solution of their waste problem, but usually no determined, competent, or continuous effort is made to study the problem in the same thorough way the modern plant executive studies problems of production and development.

It has seemed to me that the honest approach to the alleviation of industrial waste pollution is to consider the objectives to be the same as those objectives we have achieved in some phases of sewage disposal, namely, reduction of the cost of an inevitable burden that certain types of industry, those that produce liquid wastes, must assume. Modern sewage treatment has developed several sources of salvage, none of which amounts to a net profit, but several of which serve to reduce the cost of treatment and disposal, and contribute to the universal desire for conservation.

Fertilisers

The favourite diversion of the conservation enthusiast is to compute the value of the tons of nitrogen that are discharged into our streams and lakes daily in the sewage of our urban communities. This type of computation is highly fallacious, because only a small portion of the nitrogen can be recovered in the form of usable solids which have enough value to warrant their transportation to farm lands. However, there are two types of sludge that should be recovered and used as fertiliser. Digested sludge is low in fertilising value, because (a) it has been produced by biological decomposition of settled sewage solids, and (b) it contains a large amount of water. If the moisture is reduced below 10 per cent. by mechanical drying, objection (b) is eliminated, but the question then is whether the dried digested sludge is worth enough to pay for its drying. Most sewage authorities agree that it is unwise to attempt to prepare and sell digested sludge as a commercial fertiliser, but that farmers should be urged to use the air-dried sludge within truck hauling distance

* From an article in *Chem. and Met. Eng*, January 1943, pp. 78-81, by F. W. Mohlman, Director of Laboratories, Sanitary District of Chicago, and Editor of *Sewage Works Journal*.

of the sludge pile, and that the sludge should be given to them free of charge by the sewage works management.

Activated sludge is now well established as a commercial fertiliser, particularly as a source of organic nitrogen. It is practically dry, has little phosphoric acid and no potash, but the nitrogen is available and valued for green crops. The U.S. Public Health Service has recently reported results of a survey of sewage treatment in the United States, in which it is stated that there are 5403 sewage works in which sludge digestion is practised. This is 97 per cent. of all the sewage treatment plants in the U.S., but not 97 per cent. of the population whose sewage is treated, inasmuch as Chicago, Milwaukee, Minneapolis and other large cities dry sludge mechanically, without previous digestion. The population for which digestion is used may be estimated at about 35,000,000 people. If we take a per capita production of dry sludge of 75 lb. per year, a removal of 80 per cent. suspended solids, and digestion of 33 per cent. of the settled solids, there should be available annually 1,400,000 tons of air-dried sludge containing 50 per cent. moisture. This would be sufficient, at five tons per acre, to fertilise 280,000 acres, or nearly 440 sq. miles of gardens, lawns and fields.

This type of fertilisation is incomplete and not to be compared with the results that can be obtained with mixed, complete commercial fertiliser, but the sludge constitutes a source of low-grade plant food that should not be wasted. Use of dried, digested sewage sludge should be promoted as a potential source of nitrogen and plant food that is available free, except for the cost of transportation. This is an obstacle, but possibly city authorities or garden planning commissions could arrange to have sludge transported short distances to storage piles.

Gas and Power

A second source of salvage from sewage is contained in the gas produced in heated sludge-digestion tanks. This gas contains approximately 70 per cent. methane and has a net heat value of 600 B.Th.U. per cu. ft. The various steps in the development of efficient use of this gas are interesting. At first, the gas was wasted, and still is, from Imhoff tanks. Widespread research during 1920-1930 demonstrated that by heating the digesting sludge from an annual average of 60° F., as collected, to an average of 85°-90° F., the time required for digestion would be reduced by 60 per cent., thus requiring much less tank capacity and producing a more thoroughly digested and less infective sludge. The gas was then used to heat water, which was circulated through coils in the digestion tank to bring the contents up to the desired temperature. The excess gas was wasted. It was found neither advisable nor profitable to sell the sludge gas to the city's gas plant, as the amount of sludge gas produced is only a small fraction of that required by the city, and the purification, transportation and delivery of the sludge gas is too expensive to make its sale profitable.

A number of alert engineers then proposed and tested the scheme of using the gas to drive a gas engine, which furnished the power for lighting, pumping, aeration and other uses around the sewage works. The heated water from the water jacket of the gas engine circulates through the digestion tank coils, is cooled, and returns to the gas engine. Thus all gas can be used, and the power produced greatly reduces or eliminates the cost of purchased power at the sewage works. Walraven at Springfield, Ill., was a pioneer in this development. Piatt, in North Carolina, used one of the first gas engines in 1928. In 1941 there were 180 gas engines in 115 sewage works, developing 35,000 h.p. Three of the largest, of 1440 h.p. each, are at the Jamaica, Long Island, treatment works. An average of approximately 0.6 cu. ft. of gas per capita per day is produced in heated digestion tanks. Gas engines use approximately 20 cu. ft. of sludge gas per h.p. hr. or 480 cu. ft. per day. Therefore the sewage solids of 800 people, on the average, furnish enough gas to produce 1 h.p. of useful energy.

Grease

Recovery of grease from sewage and sewage sludge has always intrigued chemists and engineers. There is a long history of uneconomic attempts at recovery, and during the last war the so-called Miles Acid Process was investigated at New Haven, Conn. In this process, SO_2 was dissolved in the sewage to form sulphurous acid, the soaps were cracked to fatty acids and recovered in the sludge. It was proposed to dry the sludge and extract the grease. Grease, however, although present in the sludge in rather large amount, up to 27 per cent., was high in non-saponifiables, containing 20 to 28 per cent., and in normal times the value would be only 2 to 3c. per lb. The various grease-separating basins and processes that have been developed in sewage treatment during the past few years have not been promoted for recovery of usable grease, but rather to relieve biological treatment processes of operating difficulties. Grease in the heated digesters produces a large amount of gas, and this seems to be the preferred method of disposal of the floated grease, which is mixed with the putrescible sewer solids. For normal sewages, grease recovery continues unprofitable. It must be removed before the sewers are reached. Grease traps on army camp kitchen drains are reported to recover appreciable amounts of usable grease. Catch basins on packing-house drains have always been a profitable investment.

Australian Developments

Organic Chemicals

PRIOR to the war the only branch of the organic chemical industry that was active in Australia was the production of alcohol as a by-product of the sugar industry; though this was later extended to the production of acetic acid, mainly in connection with the Queensland sugar industry. Now Australia is turning out coal-tar derivatives such as salicylic acid, aniline, ethyl aniline, synthetic phenol (carbolic acid crystals), phthalic anhydride, phthalic esters, beta naphthol, acetylsalicylic acid, phenacetin, caffein, sulphanilamide, and other products at a constantly increasing rate. With the manufacture of phenol Australia has entered the field of plastics, which have become a most important war material. In addition considerable advance has been made in the production of special analytical chemical reagents—essential drugs such as morphia, hyoscine, the arsenicals, procaine, etc., in which vital materials, Australia can already claim self-sufficiency. An article, in *Australia To-Day*, dealing with the advances described, ends by stating that commercial enterprise has brought this new industry to a stage where Australia can keep pace with overseas development, and even may be able to make its own contributions to progress. It is a work from which all will derive benefit.

Sugar

A further article deals comprehensively with the sugar industry and the by-products of sugar cane, especially power alcohol from molasses to supplement imported supplies of petrol. This industry has grown enormously, and war-time demands for power alcohol and other products derivable from molasses now consume the total output of molasses. It has become necessary in addition to use large quantities of raw sugar for the production of power alcohol and chemicals. The bagasse—the woody residue that remains after crushing the juice out of the cane—is now used as a raw material for the manufacture of a special building board remarkable for its high insulating qualities; a large factory has been erected in Sydney for the manufacture of this material. Australia is also able to meet the increased demand for adhesives of vegetable or animal origin; she is self-supporting in glue production and her vegetable adhesive manufacture treats, from the initial stage, the raw starches grown in the country, thus avoiding reliance on overseas materials.

Some Transvaal Minerals*

Mercury : Talc : Vermiculite

THE only important known occurrence of mercury in South Africa is located in the Murchison Range, Eastern Transvaal. The Monarch Cinnabar (Pty.), Ltd., which is mining cinnabar at Monarch Kop in this area, started producing mercury in June, 1940. The original plant maintained a weekly average of two flasks, but it has been steadily expanded for larger production. Mercury production during the past year from Monarch Kop has not fallen far short of requirements in the Union, and during the present year the output may be in excess of local consumption, so that the surplus could perhaps be exported.

The Monarch Kop cinnabar is reported to occur with lenticles of quartz and crystalline carbonate in chloride-carbonate schists through a thickness of 15-20 feet in places. In the freshly-broken rock the cinnabar is of cochineal red colour, but within a short time the colour pales in the sun and after a few days no indication of cinnabar is seen. Only a thin film of the rock need be removed to expose the fresh cinnabar. There can be no doubt that the Monarch Kop deposit shows great promise so far as consistency and extent are concerned. The discovery and consequent exploitation of this mercury deposit in the Union constitute an important step towards increased utilisation of internal mineral resources; mercury is a strategic mineral, and the war has accentuated its narrowly confined world distribution.

Steatite and Soapstone

Deposits of talc exploited in the Union of South Africa are either of the foliated or massive variety, steatite or soapstone, and mainly lie in the altered ultrabasic rocks, rich in magnesia, of the Jamestown igneous complex in the Barberton district of the Transvaal. Other deposits are worked in the Pretoria district, Verulam and Zoutpansberg. Ground talc is used as a paper filler and other grades are absorbed in the leather and rubber industries, and in the manufacture of foundry facings. Apart from ground talc, cut soapstone products such as slate pencils and markers used in the metal-working and tailoring trades are produced for local

* From *The South African Mining and Engineering Journal* January, 1943.

requirements. According to the annual report of the Imperial Institute for 1941 the conclusion was reached that the most likely raw material as an alternative for American "asbestine," a fibrous talc used as a filler in rubber and certain types of paint, was an anthophyllite known to occur in the Union of South Africa. The results of preliminary tests with this material produced in the Union have been most encouraging, and have indicated that the South African material is at least an adequate substitute for the talc obtained in America. From this it would appear there is likely to be a future for this common but important South African mineral.

Exploratory work in the Eastern Transvaal has revealed that an area of serpentine lying to the north-east of Loolekop contains large reserves of vermiculite. The body has been explored by pits over an approximately circular area some 900 yards in diameter and by shafts which have remained in vermiculite-bearing serpentine to a depth of 60 feet. Below this depth a progressively larger core of phlogopite is encountered. In this locality the vermiculite occurs as large platy aggregates, which are capable of fairly easy sorting and grading. The problems of treatment for the market have been investigated by the Minerals Research Laboratory. Possibilities of ultimately developing an export trade seem not unfavourable.

Arc Welding in the U.S.A.

Savings in Time and Equipment

According to a report by R. F. Wyer, of the General Electric Company, developments in 1942 were more notable in the field of arc welding operations than in new equipment of processes. The enormous expansion in the use of arc welding was greatly aided by the conservation activity of operating men which resulted in savings of electrodes, time, electric power, and equipment. For example, many plants instituted campaigns to reduce waste in electrode stubs, some adopting the plan of checking returned stubs for number and length before issuing new electrodes from the stock room. By this means, production per pound of electrode consumed was increased as much as 20 per cent. Stress was placed on the importance of good fit-up of joints in conserving deposited metal, and of proper adjustment of welding current and arc voltage to reduce spatter loss. The co-operation of skilled operators in avoiding oversized fillets and excessive reinforcement helped still further in saving electrodes.

Savings in time were achieved by the use of larger electrodes where practicable; in many cases such use of larger electrodes resulted in an increase in production per hour of as much as 33 per cent. This trend also helped to alleviate the electrode shortage by making possible the production of greater tonnage of electrodes with existing production facilities. Higher duty factors through the reduction of electrode-changing time contributed further to increased production. Power was conserved through the more efficient use of welding machines and by the greatly increased use of A.C. welders with a consequent reduction not only in the energy consumed but in the copper wire and other facilities required to deliver the energy. Among outstanding developments were the employment of women as arc welders and the use of improved methods for the mass training of new operators. The latter effect was marked not only by the establishment of fully-equipped welding schools by individual fabricators, but also by the widespread use of motion pictures to shorten the time required for training.

A broad expansion took place in the use of previously developed equipment and processes, in accordance with the recognised necessity for standardisation and avoidance of special requirements. The application of atomic hydrogen arc welding was extended in the aircraft field where such parts as propellers, landing-gear parts, superchargers, and oxygen cylinders were produced in large volume. A new multiple-arc automatic atomic-hydrogen arc welding head went into production for the high speed welding of heavy walled tubing. Another notable development in the application field was the large increase in use of A.C. arc welding equipment, particularly its adoption in the shipbuilding field. Its use out-of-doors on sub-assembly work as well as in ship repair docks gives another strong indication of its widespread adoption in the future.

There was a significant increase in the use of control equipment on single-operator welders for facilitating the filling of craters as well as for providing increased welding heat at the start of a weld, particularly on thin materials. The resumption of development work for arc welding in atmospheres of inert gases, such as helium and argon, is particularly noteworthy. The process was commercially applied to the welding of magnesium, aluminium, and stainless steels. The demand for men skilled in the application of oxy-acetylene processes has led the International Acetylene Association, New York, to publish a 88-page pamphlet for instructors, entitled "Training Oxy-Acetylene Welding and Cutting Operators."

Personal Notes

MR. E. A. MERCER, of Imperial Chemical Industries, Ltd., has been elected president of the Manchester engineers' club.

MR. C. J. BROCKBANK, Controller of Abrasives in the Ministry of Supply, will in future be in control of graphite also.

MR. J. H. HOPE, for 57 years a chemist with Scottish Oils, Ltd., has retired from the company's service.

MR. A. CROOKS, manager of Tennants Salt Works (I.C.I.), Ltd., Haverton Hill-on-Tees, for 26 years, has retired after 44 years' service with the company.

PILOT-OFFICER A. H. COMBER, R.A.A.F., of Swift and Co. Pty., Ltd., who was posted missing after air operations over Italy, is now reported safe and well as a prisoner of war in Italy.

The Gas Research Board has appointed DR. J. G. KING, superintendent of the Fuel Research Station, to be its director, and DR. F. J. DENT to be joint assistant director. DR. W. T. K. BRAUNHOLTZ is secretary.

MR. IAN F. L. ELLIOT, until recently head of the Steel Division of the British Raw Materials Board in Washington, has been appointed chairman of the Eastern Group Supply Council, the object of which is to make Eastern theatres of war as self-supporting as possible. Before the war Mr. Elliot was managing director of the British Iron and Steel Corporation.

Obituary

The death is reported of MR. THOMAS WORRALL, of Kelvin, Bottomley and Baird, Ltd., Hillington, who died suddenly in Glasgow on April 3, aged 54.

MR. JOHN CLUNIE MENZIES, chairman of Scottish Agricultural Industries, Ltd., Leith, died at Reston, Berwickshire, on March 30.

MR. T. J. H. MCQUEEN, until recently chief chemist at the iron and steel works of the Glasgow Iron and Steel Company, has died at Wishaw.

MR. GILBERT CHARLES WARDLE, chairman of Joshua Wardle, Ltd., weighters, dyers, and finishers, Leek, Staffs., and a principal of Wardle and Davenport, Ltd., died at Leek on March 31, aged 80.

DR. ALFRED ARCHIBALD BOON, D.Sc., Emeritus Professor of Chemistry at Heriot-Watt College, Edinburgh, has died, aged 81. Taking charge of the Chemistry Department in 1913, he was appointed Professor in 1919, and retired in 1931.

DR. HENRY FORSTER MORLEY, M.A., D.Sc., F.I.C., who died at Midhurst, Sussex, on April 3, aged 87, was formerly director of the International Catalogue of Scientific Literature and of the Royal Society's Catalogue of Scientific Papers. He was Assistant Professor of Chemistry at University College, London, in 1884-88, and from then until 1901 was Professor of Chemistry at Queen's College. He was joint editor of Watts's *Dictionary of Chemistry*.

MR. ALFRED DAVIES, joint managing director of English Clays Lovering Pochin & Co., Ltd., and of many other china-clay, quarrying, and engineering companies, died on April 5 at St. Austell, Cornwall (his native town), aged 61. He had been connected with the china-clay industry since 1907, when he joined the West of England China Clay Company, and by his many visits to the U.S.A. and the Continent had played a large part in the development of the export trade. After the last war he became works manager of English China Clays, Ltd., and, following the big china-clay merger in 1932, was appointed a director of the combined company in 1935, and joint managing director, with Mr. John Keay, in 1937.

New Control Orders

Iron and Steel

The Minister of Supply has made the Control of Iron and Steel (No. 31) Order, 1943 (S.R. and O. 1943, No. 502), which came into force on April 6 and varies the No. 15 Order: (a) by substituting for the present control of "constructional steelwork for inclusion in the structure of a building," a control of "constructional steelwork" for whatever purpose it is used; (b) by including iron molybdate in the controlled materials; (c) by reducing the small quantities of iron and steel products which may be purchased free of licence; and (d) by amending some of the controlled maximum prices both in the 5th Schedule and in the Related Schedules.

In addition, the provisions in regard to the use of departmental authorisations (M forms) have been varied so as to allow the acquisition of steel for conversion into constructional steelwork. Hitherto, constructional steelwork could be bought on the authority of M forms, but the steel for conversion into constructional steelwork required a licence. The new 3rd and 4th Schedules to the Order contain the reduced quantities which may be acquired without authority, and a note summarising the alterations in the related schedules.

New sulphur deposits are to be opened up in the Tacora district, Arica Province, Chile, according to *Foreign Commerce Weekly*. The Corporatión de Fomento has granted 300,000 pesos to the Cia. Azufrera Aguas Calientes for this work.

General News—From Week to Week

The Ministry of Food announces that there is no change in the prices of oils and fats for the four weeks ending May 1.

The Controller of the Anglo-Spanish Clearing Office announces that the rate of commission was reduced on April 1 from ½ per cent. to ⅜ per cent.

The establishment of a joint industrial council for the Irish tanning industry was decided upon at a meeting of the industry in Dublin recently. Mr. D. Sullivan, Minister of Industry and Commerce, was asked to appoint a chairman and secretary.

Membership of the Institution of Chemical Engineers increased from 1245 at the end of 1941, to 1322 at the end of 1942. During the year, the deaths of nine members, three Associate-Members, and three Graduates fall to be recorded.

The Barrow Hæmatite Steel Company has approved the sale to the Ministry of Supply of the company's steel works and hoop and bar mills for £640,000. The company will retain its iron works, iron ore mines, and limestone quarries.

Copies of this year's edition of the Bristol Engineering Directory, which has just been published, may be obtained from the Bristol Engineering Manufacturers' Association, 104 Filton Avenue, Bristol, 7, price 9d. each. As only 2000 copies of the directory, which has been completely revised, are available, application should be made at once.

Closer collaboration between Government Departments, industrialists, nutritional scientists, the trade unions representing the workers using and employed in the canteens, and the caterers, was called for by Mr. Harold Gardner, the newly-elected chairman of the National Society of Caterers to Industry, at a recent meeting. By working together instead of separately, he said, we could make great headway. Lord Woolton's leadership, his Society felt, would guarantee success.

Many chemists are finding it difficult to get distilled water from the usual suppliers owing to transport and other difficulties. But instead of applying to the Board of Trade for licences to get stills of their own, the "have-not" chemists are asked by the Board of Trade to make use of the facilities offered them by the neighbouring "haves" to use their stills. By encouraging arrangements of this kind between those who have and have not got stills, the Board of Trade hopes, at this time when all possible productive effort must be devoted to direct war production, to save much machinery and labour.

A note on the laboratory technique of the phosphatase test for heat-treated milk (addendum to Memo. 139/Foods) has been published by the Ministry of Health, and is obtainable from H.M. Stationery Office (1d.; post free 2d.).

Foreign News

No purchaser of laboratory equipment in the United States is now permitted to obtain any item valued at more than $50 without authorisation from the Director General for Operations.

A shortage of 50,000 tons of metallurgical grade fluorspar is expected in the United States during 1943. A voluntary scheme to reduce consumption by steel producers by 10 to 15 per cent. has been organised.

Plans to increase the supply of copper from Northern Rhodesia involve an estimated expenditure of £1,500,000, and the Ministry of Supply is to make a grant of half the sum expended.

Cobalt is now subject to complete allocation in the United States, except for quantities of 25 lb. or less which may be delivered during any one month to any consumer without specific authorisation from W.P.B. Lithium ores have also been placed under complete allocation.

Recent surveys in Uganda have shown that considerable deposits of 30 minerals occur in the Protectorate, and smaller quantities of 19 more. Production of many of the minerals is being developed to meet the war demands of the United Nations, with tin, wolfram, and tantalite first on the list.

Coal production in Canada amounted to 18,707,110 tons in 1942, according to a preliminary official estimate. Of this total, about 38 per cent. was produced in Nova Scotia and about 41 per cent. iin Alberta. Ontario accounted for all the 210 tons of peat produced for fuel in 1942.

The first butadiene plant to produce raw material from petroleum for the Government's synthetic rubber programme is now in operation at Baton Rouge, Louisiana. Its annual capacity of 6600-9000 tons of butadiene is enough to produce rubber for 1,300,000 to 2,000,000 tyres.

Sodium perborate is advocated by textile chemists of the U.S. Department of Agriculture as a good stain remover, particularly for white woollens, which it leaves soft and fluffy. The solution—four tablespoons of perborate to a pint of lukewarm water—must be used quickly, or it loses strength. Thorough rinsing with water is necessary after stains have been removed.

The Government of Bulgaria, through its Agricultural Ministry, has constructed 30 fruit and vegetable drying plants on State farms and at agricultural schools, reports the Axis Press. Over 200,000 kg. of vegetables and 50,000 kg. of fruit will be processed annually.

Phenol-formaldehyde plastic tyre treads have been developed by Monsanto chemical engineers for industrial hand trucks. Although less resilient and noisier than real rubber, the plastic tread runs easily over smooth surfaces and is rapidly attached to a wheel.

A deposit of phlogopite mica in Central Australia, discovered by Mr. G. A. Johansson, is being developed by a party of civilian constructional corps workers. The Central Australian mine has produced 1420 lb. of high-quality mineral, and it is hoped production will soon be on a much larger scale.

The Ceylon State Council has decided to advocate an increase in the price of rubber from 70 cents to 1 rupee per lb. A motion authorising the Executive Committee for Agriculture and Lands to take immediate possession of all untapped rubber plantations, so as to produce the maximum output, has also been approved.

Forthcoming Events

The annual general meeting of the London and district section of the **Institution of the Rubber Industry** will be held in the cinema of the Imperial Institute, S. Kensington, S.W.7, on **April 12,** at 6.45 p.m. At 7 p.m. there will be a film display, which will include a new colour film on synthetics.

The annual general meeting of the **Society of Glass Technology,** to be held at "Elmfield," Northumberland Road, Sheffield, will be followed by a conference on "Youth and Technical Education." This will be opened by Mr. George Chester, of the General Council of the T.U.C., on the afternoon of **April 13.** The conference will continue throughout the following day, and contributors will include gentlemen eminent in the glass industry and in education.

The Trueman Wood lecture of the **Royal Society of Arts** will be given by Mr. J. G. Crowther, at 1.45 p.m., on **April 14.** The subject will be "Science in Soviet Russia."

A meeting of the Road and Building Materials Group of the **Society of Chemical Industry** will be held in Gas Industry House, Grosvenor Place, on **April 14,** at 5 p.m., when Mr. R. C. Bevan will present a paper on "Experience of the Behaviour of Building Materials in Fires."

The ninth Liversidge lecture of the **Chemical Society,** entitled "Magnetochemistry" will be given by Professor S. Sugden, in Burlington House, at 2.30 p.m., on **April 15.**

The annual general meeting of the Birmingham and Midlands section of the **Society of Chemical Industry,** which will take place at 5.30 p.m., on **April 16,** will be followed by a lecture on "Glasses: Synthetic and Safety," by Dr. A. C. Waine.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

ADVANCE WELDING CO., LTD., London, W.C. (M., 10/4/43.) March 20, by order on terms, 22 debentures of £50 each, to Mrs. G. E. H. Booth, Bolton, and six debentures of £50 each, to Mrs. S. Y. Tiplady, London; general charges.

County Court Judgments

McAINCH, A. (male), Milking Stile Lane, Lancaster, works chemist. (C.C.J., 10/4/43.. £11 11s. 1d., February 19.

Company Winding-up Voluntarily

DRY WASHERS (COAL & MINERALS), LTD. (C.W.U.V., 10/4/43.) By special resolution, March 19, G. Raw, Ravenswood, Low Fell, Durham, appointed liquidator.

Winding-Up Petition

SHEPPERTON POLISHING & PLATING WORKS, LTD. (W.U.P., 10/4/43.) A petition for winding-up has been presented by Hans Otto Mankiewitz, 10 "Greenhill," Hampstead High Street, London, and was heard at the Royal Courts of Justice, Strand, London, on April 5.

Company News

William Blythe and Co., Ltd., announce a dividend for the year, of 15 per cent. (same).

Monsanto Chemicals, Ltd., announc an ordinary dividend of 16⅔ per cent. (same), and a net profit of £75,748 (£67,958).

The British Oxygen Co., Ltd., announce a final dividend for 1942, of 8 per cent., making 15 per cent. (14 per cent.).

United Glass Bottle Manufacturers, Ltd., announce a net profit for 1942 of £194,752 (£196,317), and a final dividend, on the ordinary stock, of 6 per cent., together with a cash bonus of 2½ per cent., making 12 per cent. for the year (same).

The Manganese Bronze and Brass Co., Ltd., announce a net profit for 1942, of £47,469 (£45,979), and a final dividend of 17½ per cent., making 25 per cent. (same).

New Companies Registered

William Somerville and Son, Oil Refiners, Ltd. (22,356).—Capital: £10,000 in £1 shares. Unlimited company now registered in Edinburgh with limited liability. Wholesale and retail oil refiners, etc. Directors: J. M'Gougan, R. Speirs. Registered office: Blantyre Oil Works, Blantyre, Lanarkshire.

Marriot Gregson and Co., Ltd. (379,690).—Private company. Capital: £100 in 100 shares of £1 each. Importers, exporters, buyers and sellers of general merchandise, including metals, plant, tools, chemicals, oils, waste goods, etc. Directors: R. L. Andrews, C. A. Rust. Registered office: 39 Cheapside, E.C.2.

Littleshaw and Co., Ltd. (379,722).—Private company. Capital: £10,000 in 10,000 shares of £1 each. Manufacturers of moulding powders and materials, synthetic powders, plastic materials, mouldings, pottery, rubber, glass, etc. Directors: G. E. Titley, A. Pritchard, W. R. Mitchell. Registered office: 61/3 St. Paul's Churchyard, E.C.4.

Eden Chemical Company, Ltd. (379,600).—Private company. Capital: £1000 in 1000 shares of £1 each. Manufacturers of and dealers in heavy and general chemicals, cleaning agents, oils, grease, dyes, colours, manufacturers of and dealers in chemical by-products, etc. Directors: J. W. Lees, Jennie Lees. Registered office: Eden Street Works, Eden Street, Blackburn.

United Resin Developments, Ltd. (379,731).—Private company. Capital: £1000 in 2000 "A" and 2000 "B" shares of 5s. each. Manufacturers of and dealers in plastic powders, glass, refractory materials, chemicals, resins, bakelite, vulcanite, ebonite, rubber, porcelain, etc. Subscribers: C. R. Webb, 25 Ethelburga Street, S.W.11; J. Wynne. Solicitors: Stephenson Harwood and Tatham, 16 Old Broad Street, E.C.2.

Chemical and Allied Stocks and Shares

THE trend of the war news has continued to induce a firm undertone in the stock and share markets. This was, however, due more to absence of selling than to improvement in demand. Securities of chemical and kindred companies were firm in accordance with the general tendency, and individual features were not lacking. Imperial Chemical continued active in front of the dividend announcement, and at 39s. 4½d. were well maintained as compared with a week ago. Lever & Unilever at 35s. 6d. were slightly lower on balance, while General Refractories, which remained under the influence of the improved dividend of 7½ per cent., were firm at 16s. 1½d. Stewarts & Lloyds deferred at 54s. were little changed on balance, aided by the maintenance of the dividend; Tube Investments had a firm appearance at 93s. 6d. Borax Consolidated deferred regained an earlier small decline, and at 34s. 9d. were unchanged on balance; the preferred ordinary and preference units held their gains, the recently-issued results having tended to draw attention to the good cover for dividend requirements. Awaiting the Budget, the units of the Distillers Co. remained around 83s. 6d.

United Glass Bottle Manufacturers ordinary shares were steady at 60s. xd.; it is apparent from the preliminary statement for the past year's working that the 12 per cent. payment on the shares is again a conservative distribution and that the full results will show that a good proportion of the profits is being used to add further strength to finances. The small yield shown on U.G.B. ordinary shares, and on numerous other leading industrial securities, is explained by the strong financial position and the important bearing this will probably have in dealing with problems that will arise after the war. Murex ordinary were firm at 106s. 10½d.; this is another instance where the market price of the shares is influenced as much by the strong balance-sheet as by the question of the immediate dividend yield. Similar remarks apply to British Match ordinary, which were 38s. 6d., and also to Boots Drug 5s. ordinary, which, at 41s. 6d., were a few pence above the level ruling a week ago. Metal Box ordinary were slightly higher at 85s. 6d., while British Oxygen showed firmness at 76s. 3d. "ex" the dividend. International Paint held their rise to 112s. 6d. At 66s. 3d. Nairn & Greenwich also maintained their recent improvement, but elsewhere Barry & Staines eased slightly to 41s. 9d. Wall Paper Manufacturers deferred at 37s. 3d. were unchanged on balance.

B. Laporte remained firmly held and were again quoted at 78s. "middle." Burt Boulton were around 19s., and Greeff-Chemicals 5s. ordinary 7s. 7½d. Monsanto Chemicals 5½ per cent. preference remained at 22s. 6d. Better demand continued for Imperial Smelting, which, at the time of writing, have improved further to 14s. Elsewhere, Associated Cement rallied to 60s., awaiting the financial results. British Plaster Board strengthened to 28s. 3d. Among plastics, British Industrial Plastics 2s. ordinary were again 5s. 10½d. Erinoid 11s. 6d, and Lacrinoid Products 4s. 7½d. In other directions, Cellon 5s. ordinary further improved, having transferred up to 19s. 3d.; the financial

results are due in a few weeks. Business at 15s. 6d. has been recorded in Midland Tar Distillers shares, at close on 10s. in British Tar Products 5s. ordinary, while British Drug Houses were 22s. Elsewhere, Morgan Crucible 5 per cent. preference marked 24s. 3d. Leeds Fireclay preference, which kept under the influence of the resumption of dividends, changed hands up to 16s. 3d. Indestructible Paint shares were more active around 101s. pending declaration of the dividend. Recent gains in leading oil shares were not fully held.

British Chemical Prices

Market Reports

THERE have been no outstanding movements in the market for general chemicals this week, firmness in quotations being a general feature. In most sections of the market the supplies for immediate delivery are very scarce and in consequence new business is restricted. On the other hand, ex contract deliveries to the chief consuming industries continue along steady lines and specifications cover good volumes. In the soda products section sellers report that contract parcels of industrial refined nitrate of soda are being steadily called for, and there is a fair movement of supplies of both soda ash and bicarbonate of soda. Caustic soda and caustic liquor are going into consumption in good quantities at a firm range of prices. Prussiate of soda remains a very limited market and quotations are extremely firm. In the potash section there is a steady demand for acid phosphate of potash, while yellow prussiate of potash is in very short supply and quotations cover rather a wide range. In other directions British-made formaldehyde is attracting a fair amount of new inquiry and a steady demand is reported for peroxide of hydrogen with quotations unchanged in each case. White powdered arsenic keeps very firm and a brisk trade is reported. Conditions in the coal-tar products market remain much the same as reported last week.

Manchester.—A generally firm price position has been reported on the Manchester chemical market during the past week, and although actual rates show little change on balance, the trend in several sections seems to be towards higher levels. The bleaching, dyeing and finishing trades are taking fair quantities of a wide range of heavy chemicals against contracts, while most other industrial outlets are specifying regularly for satisfactory quantities, with the alkali products, in particular, moving well. Strong price conditions generally are a feature of the by-products market, and the light, as well as most of the heavy classes, are meeting with a good demand.

Glasgow.—In the Scottish heavy chemical trade the position remains unchanged, home business maintaining its steady transactions. Export trade still remains very restricted. Prices continue to be very firm with no actual changes to report.

BRITISH ASSOCIATION OF CHEMISTS

Unemployment Insurance, total funds over £28,000
Legal Aid. Income Tax Advice.
Appointments Service.

Write for particulars to :—

C. B. WOODLEY, C.R.A., F.C.I.S., General Secretary, B.A.C.
"Empire House," 175, Piccadilly, London, W.1
Phone: REGENT 6611

SITUATION VACANT

None of the advertisements below relates to a woman between 18 and 41 unless such a woman (a) has living with her a child of hers under the age of 14, or (b) is registered under the Blind Persons Acts, or (c) has a Ministry of Labour permit to allow her to obtain employment by individual effort.

FULLY qualified Industrial Chemist required for London Firm of Engineers and Cable Makers, to undertake research and development work on plastic and insulating materials. Sound knowledge and experience of chemistry of synthetic resins and plastic materials essential. Age 25-35. Salary about £400 p.a. in accordance with training, qualifications and experience. Write to Box No. 2111, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

EDUCATIONAL

Great Possibilities for

QUALIFIED CHEMICAL ENGINEERS

Key Men in Wartime and Afterwards.

Many of the finest posts in Britain in War-time are reserved for Chemical Engineers. The same will be the case when the war is over. The vast technique and experience now being applied to Chemical Technology for war purposes will then be suitably utilised in reconstruction, and in trade and commerce.

Enrol with the T.I.G.B. for the A.M.I. Chem. E. Examinations in which home-study Students of The T.I.G.B. have gained :—

TWO " MACNAB " PRIZES

Write to-day for " The Engineer's Guide to Success "—free, containing the world's widest choice of Engineering Courses—over 200—the Department of Chemical Technology including Chemical Engineering Processes, Plant Construction, Works Design and Operation, and Organisation and Management—and which alone gives the Regulations for A.M.I.Chem.E., A.M.I. Mech.E., A.M.I.E.E. C. & G. B.Sc., etc.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN,
219 Temple Bar House, London, E.C.4.

FOR SALE

SECOND-HAND DISINTEGRATORS FOR SALE.

ONE—4½ size DISINTEGRATOR by Christy & Norris, with automatic worm feed; beater chamber 4 ft. 6 in. dia.; 1,300 r.p.m.; 60 H.P. required to drive.

Five—3½ size DISINTEGRATORS by Harrison Carter; beater chamber 3 ft. 3 in. dia.; 1,700 r.p.m.; 28 H.P. required to drive.

Two—2½ size DISINTEGRATORS by Christy & Norris; beater chamber 2 ft. 6 in. dia.; 2,500 r.p.m.; approx. 18 H.P. required to drive.

One—1½ size DISINTEGRATOR by Christy & Norris; beater chamber 1 ft. 10 in. dia.; 3,300 r.p.m.; approx. 12 H.P. required to drive.

One—size " C " DISINTEGRATOR by Harrison Carter; beater chamber 2 ft. 6 in. dia.; 2,700 r.p.m.; approx. 20 H.P. required to drive.

One—size " B " DISINTEGRATOR by Harrison Carter; beater chamber 1 ft. 10 in. dia.; 3,500 r.p.m.; approx. 12 H.P. required to drive.

One—No. 2 size DISINTEGRATOR by Booth; 3,200 r.p.m.; approx. 40 H.P. required to drive.

One—Motor-driven " Woodburn " type DISINTEGRATOR by Baker Perkins, arranged with worm feed; body of machine 18 in. dia. by 22 in. long; complete with fan and cyclone; driven by 25 H.P. D.C. motor running at 3,000 r.p.m.

One—3-stage MULTIPLE GRINDER by Hardy Patent Pick Co.; chambers 28 in., 24 in. and 22 in. dia.; complete with feed hopper and connections at side for cyclone attachment; driven through fast pulleys.

GEORGE COHEN, SONS & CO., Ltd., STANNINGLEY, near LEEDS, and WOOD LANE, LONDON, W.12.

100 REBUILT Hydro Extractors by all leading makers from 18 in. upwards with countershafts attached and safety covers. Jacketed Steam Pans, various sizes. List on request. Seen at Randalls, Arundel Terrace, Barnes. Telephone: Riverside 2436.

A

D

S

W

JA

TI

Te

Printed in Great Britain by THE PRESS AT COOMBELANDS, LTD., London and Addlestone, and published by BENN BROTHERS, LTD., at Bouverie House, 154, Fleet Street, E.C.4., April 10th, 1943. Entered as Second Class Matter at the New York, U.S.A., Post Office.